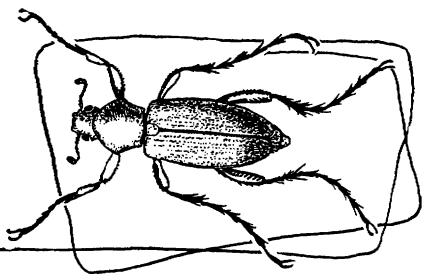


Pests on Ornamentals



Insect Pests of Flowers and Shrubs

C. A. Weigel, R. A. St. George

Many kinds of insects beset flowers and shrubs about the home and in greenhouses. The injury they do depends on their feeding and egg-laying habits. Some insects feed on the seed as soon as it is planted. Others attack the young seedling as it breaks through the ground. Still others infest the flowers, leaves, stems, or roots.

Injury to the leaves may consist of mining the interior, skeletonizing the surface, and eating part or all of the foliage. Injury to the terminal shoot may be caused by external feeding, by the chewing of holes through the surface, and by tunneling extensive mines in shrubs between the bark and wood or even in the wood itself. Such injury may cause the stunting or death of the terminal growth beyond the point of attack. Certain insects also hollow out the interior of terminal buds and shoots of hardy shrubs. A few make pits in the surface of the bark of the main stem after settling there and feeding for a while. One other type of injury consists of the removal of the cell sap by the feeding of certain insects or mites on the stem, foliage, or other parts of the plant; the part attacked may have a stippled appearance. Injury to the roots may consist of feeding on the young rootlets and—on shrubs—of chewing through the bark

surface or boring direct into the wood. Further injury consists of the formation of galls, which may occur on any part of the plant.

The effect of the various kinds of injury depends largely upon the intensity of insect infestation and the vigor of the plants. It may range all the way from making the plants only slightly less attractive in appearance to seriously weakening, stunting, or killing them. The maximum effect of such injury is apt to be most marked during or immediately following periods of drought or transplanting operations, when it is difficult for the plants to get adequate moisture and food.

Because insect enemies of flowers and shrubs are of many kinds, it would be difficult for the average person to identify them without first knowing the different groups involved. We therefore group them as leaf-chewing insects, sucking insects, leaf-mining insects, gall-forming insects, tip- and stem-infesting insects, and soil- and root-infesting insects. We give a few examples of each group and an account of the injury they cause, their habits, and control.

To control insects outdoors, insecticides are usually applied as sprays, dusts, or baits. In the greenhouse they may be sprays, dusts, baits, fumigants, and aerosols, although aerosols have been made so effective that they have nearly replaced other methods in greenhouses.

LEAF-CHewing INSECTS bite off the foliage and chew and swallow the plant tissue. Therefore they generally are controlled by a stomach poison. Chief among them are caterpillars, sawflies,

and beetles: The bagworm, cutworms, the fall webworm, the juniper webworm, the eastern tent caterpillar, sawflies, the catalpa sphinx, the rose chafer, the rose curculio, cucumber beetles, the Japanese beetle, blister beetles, flea beetles, and the imported willow leaf beetle.

The bagworm is a caterpillar that lives in a silken, cocoonlike bag, to which are attached bits of leaves from the host plant. It gradually increases the size of the bag as it grows. By late summer it is about 2 inches long. At that time it attaches itself to a twig. The female is wingless and remains in the bag, where she lays a mass of eggs. The winter is passed in the egg stage. The eggs hatch in May in the South and late May or early June in the North. Bagworms prefer to feed on arborvitae and juniper but also infest many other evergreen and deciduous trees and shrubs.

Treatment: Destroy all mature bags in the spring before growth starts in order to kill the overwintering eggs. If that is not done, spray with lead arsenate soon after the caterpillars hatch (about June 1 in Washington, D. C.), using stronger dosages for the larger caterpillars. A 2-percent emulsion of chlordane or parathion as a wettable powder is also effective. DDT is inferior to arsenate of lead against bagworms, particularly the more mature larvae.

Cutworms are seldom seen. They usually remain hidden under clods of earth or in the topsoil by day. Evenings they emerge to feed. They cut off small plants at or near the ground line, climb the plants, and feed on the foliage or bore into the developing flower buds. Plants are usually ruined overnight. One cutworm can kill several plants.

Cutworms are smooth, plump caterpillars, gray or brownish, and 1 to 2 inches long when full-grown. They hatch from eggs laid by brownish moths late in the summer. By late fall they are nearly full-grown and bury themselves in the ground for protection during the winter. Among the sev-

eral species, the variegated cutworm probably is the most serious, both under glass and outdoors.

Treatment: Poison bait consisting of a mixture of sodium fluosilicate or paris green mixed with wheat bran is a standard remedy. The moist bait is scattered thinly over the infested area late in the evening when the caterpillars are active. DDT in dust or spray mixtures is said to be superior to baits in greenhouses.

Poisonous caterpillars occasionally eat and injure garden plants, shrubs, and trees. Most caterpillars are not poisonous, although several species have stiff, poisonous hairs or spines that may cause a painful, burning sensation when they come in contact with tender skin.

The saddleback caterpillar, the best known, attacks several kinds of flowers and shrubs. It is brown at each end; the middle is green with a purple center that resembles a small saddle. Poisonous caterpillars are seldom found in greenhouses.

Treatment: Spray the leaves with DDT or lead arsenate. If only a few caterpillars are present, they may be picked by a gloved hand.

Sawfly larvae injure roses by skeletonizing the foliage or chewing large, ragged holes in the leaves. Three species are concerned. They are often called false caterpillars or slugs. The adults are small, wasplike insects. The females deposit their eggs in slits "sawed" in the leaves.

A common species is the bristly rose-slug. The young larvae skeletonize the leaves on the under side and give a glazed appearance to the foliage. As they increase in size they eat large holes and often leave only the larger veins. Full-grown slugs are about one-half inch long and are dirty, yellowish green with a darker green stripe on the back. The body bears stiff hairs, from which the name is derived.

Treatment: Spray or dust with DDT or lead arsenate. If diseases or mites are present, add sulfur to the mixtures. Nicotine sulfate and derris are effective

against the young slugs. Frequent spraying or washing of plants with a stream of water under pressure will keep them free of the slugs.

The *spotted cucumber beetle* is typical of several species that attack flowering plants. It feeds on the leaves, buds, and flowers. Its chief injury consists in eating holes in the blossom petals. If many beetles are present, their excrement often discolors the blossoms. Injury is likely to be most serious in late summer or early fall. At that time many of the more favored host plants have matured or become unpalatable and the beetles migrate to asters, dahlias, and other late-season flowers. The beetles are about one-fourth inch long and yellowish green, with 12 black spots on the wing covers. They winter in the adult, or beetle, stage. The eggs are laid in the ground in the spring. Newly hatched larvae feed on the roots of various garden plants and weeds for about a month before the adults emerge.

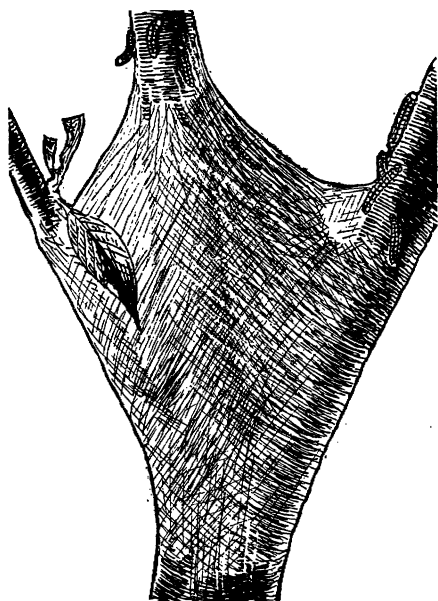
Treatment: Spray or dust the plants with DDT or chlordane every 2 or 3 weeks. Repeated applications are recommended because the beetles are apt to be present in the surrounding area and thus are likely to be a recurrent problem.

The *rose chafer* is an outstanding pest of the blooms of the rose, iris, and peony. It also attacks the flowers of many other plants. It is a long-legged, yellowish-brown beetle about one-third inch long. It often appears in swarms rather suddenly in June or early July and continues its ravages for a number of weeks.

Treatment: If only a few plants are involved, shake the beetles into a pan of water, covered with a film of kerosene or other oil, early in the morning before they become active. Otherwise, DDT or chlordane as a dust or spray is recommended.

SUCKING INSECTS get their food by inserting their mouth parts through the surface of the plant and drawing the sap into their bodies. They are

usually controlled by contact poisons, which destroy them by affecting the nervous systems, corroding their bodies,



Eastern tent caterpillar nest.

or suffocating them. This group includes aphids, leafhoppers, treehoppers, scale insects, mealybugs, thrips, lace bugs, psyllids, plant bugs, spittlebugs, chermids, and spider mites.

Aphids, or plant-lice, infest all sorts of plants, including annuals, perennials, and shrubs. Usually they do not kill the plants but frequently reduce plant vigor, curl or distort the leaves, harden the buds, or cause malformation of the flowers. They usually occur in colonies or clusters on the new growth, at the base of buds, or on the under sides of the leaves. Infested plants often are visited by large numbers of ants and other insects that feed upon the honeydew excreted by the aphids—a sweet, sticky, liquid excretion that often coats the leaves or objects immediately below the aphids and gives them a varnished or sooty appearance, which results from a sooty mold that develops on the honeydew.

Aphids are soft-bodied insects, whit-

ish, greenish, or blackish. They have pear-shaped or nearly globular bodies and comparatively long legs. They are usually not over one-eighth inch long. Many are smaller. Most are without protective covering, but some of the woolly aphids are covered with white waxy threads.

Some species attack the roots of asters. Others infest flowering bulbs, such as tulip, iris, and crocus. Certain aphids carry plant diseases. The green peach aphid is a vector of carnation mosaic, lily mottle virus, pansy and viola flower breaking, and mosaic diseases of gladiolus and several other plants.

Treatment: Spray or dust infested plants with nicotine sulfate, rotenone, or pyrethrum. Chlordane, in the form of dusts or sprays, is effective; so is spraying with tetraethyl pyrophosphate or lindane.

To control root-infesting aphids this procedure has been reported to be effective: Make a shallow trench around the base of the plants. Into it pour enough chlordane emulsion to soak the ground and reach the infested roots. Then replace the soil in the trench.

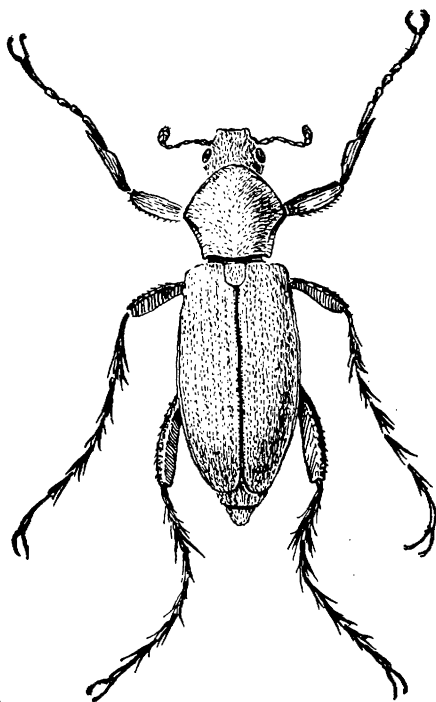
To control aphids under glass, use a spray or dust, or fumigating may be done with hydrocyanic acid gas or nicotine smokes. But aerosols containing tetraethyl dithiopyrophosphate, parathion, or DDT are more effective and easier to apply and have largely replaced the older methods.

To control aphids on dormant bulbs, such as tulip, gladiolus, iris, lily, and crocus, immerse the infested material in a hot water bath.

Fumigation with hydrocyanic acid gas or methyl bromide in a special chamber designed for the purpose also is effective but must be done with great caution.

Thrips attack foliage, buds, flowers, and bulbs of ornamental plants outdoors and in greenhouses. Certain species carry virus diseases of flowering plants. Some thrips feed on and destroy other insects and therefore are very beneficial.

The gladiolus thrips is an outstanding pest. It causes the usual type of thrips injury and also feeds on the



Rose chafer.

gladiolus corms in storage. The fed-over spots become russeted. The infested leaf sheaths become brown and the leaves silvered. The bud sheaths dry out and appear straw-colored. The flowers have whitish streaks. In severe cases the spikes never show color but turn brown and appear blighted. The adult of this thrips is a tiny insect with a brown body and a white band at the base of the featherlike wings.

Treatment: The harvested gladiolus corms should be allowed to dry for about a month and then treated with DDT. Small lots may be treated in tight paper bags and larger quantities in trays. If treatment is delayed until late in the storage period, dipping in a Lysol solution (1 tablespoonful in 1 gallon of water) just before planting is recommended. To control thrips on the growing gladiolus and other plants, spray or dust with DDT on the first

sign of injury. Chlordane, parathion, and toxaphene are reported to be quite effective.

Leafhoppers injure plants in various ways. The draining of the plant juices may cause a whitening and curling of the leaves and killing of the tender tips, as in the case of the rose leafhopper. The potato leafhopper causes a dying of the edges of dahlia and other leaves, a condition known as hopperburn. Some species transmit plant diseases; for example, the six-spotted leafhopper transmits the virus of aster yellows from diseased to healthy plants.

Leafhoppers are slender, delicate insects, usually one-eighth inch or less in length. They vary from brown to pale green. They are very active and hop a considerable distance when disturbed. Eggs are laid in the leaf tissue or stalks. Two or more broods may occur annually. Aster, calendula, dahlia, gladiolus, hollyhock, marigold, rose, and zinnia are among the many plants they commonly attack.

Treatment: Standard insecticides like pyrethrum, nicotine sulfate, and copper-containing compounds are used extensively against leafhoppers. DDT and chlordane are more effective, however.

Lace bugs attack such plants as azalea, chrysanthemum, firethorn, and rhododendron. There are several species, but their appearance and the type of injury they cause are similar. The common azalea lace bug is typical. It winters in the egg stage on the leaves. About midspring the eggs begin to hatch. The immature insects, the nymphs, are small and shiny. The adults are about one-eighth inch long. Their thin, lacelike wings lie flat over their oval bodies. In summer both nymphs and adults suck the juices from the under sides of the foliage. That causes the upper surface of azalea leaves to have a spotted or mottled discoloration and an unhealthy look. The lower surface becomes spotted with many flattened specks of blackish, shiny excrement.

Treatment: The usual treatment is

to spray the under sides of the leaves with nicotine sulfate or pyrethrum when the nymphs first appear in the spring. A spray made of white-oil emulsion and derris powder or of white-oil emulsion and nicotine sulfate also is effective. DDT used in the form of an emulsion, wettable powder spray or dust, or as an aerosol is good. Parathion or lindane wettable powders also may be used as a spray.

The boxwood psyllid causes a characteristic cupping of the terminal leaves as the result of its feeding. It is a small, grayish-green, sucking insect related to aphids. The nymphs are covered with a whitish waxy material and appear in early spring. Plants are seldom injured seriously, although their appearance may become unattractive. Severe infestations may retard growth.

Treatment: Spray with DDT, parathion, or a nicotine sulfate and soap solution or pyrethrum at the first evidence of leaf cupping or occurrence of the psyllid. A second or third spraying, at intervals of 10 days, may be necessary for a heavy infestation.

Recent research indicates that if control measures are directed toward the adults, rather than the nymphs, the plants will be free of insects the following spring and the cupping injury will be avoided. Such application kills the adults before they can lay eggs and thus eliminates the nymphs, which otherwise would be present to cause injury. The same insecticide as used for the nymphs should be applied about the middle of June in places that have a climate like that of Washington.

Plant bugs are sucking insects that injure many plants. The principal species are the phlox plant bug, tarnished plant bug, four-lined plant bug, and yucca plant bug.

The phlox plant bug feeds in all stages on the upper surfaces of the more tender leaves and buds of perennial phlox. Injured leaves show white or pale-green spots on the upper surfaces. Often the plant becomes stunted, and the blossom head loses its symmetry. Sometimes the entire plant is

killed. The adult bug, not over one-fourth inch long, is very active and may be recognized by its dull orange or reddish wing covers and a black stripe on the back. The adults from the summer brood lay their eggs in the fall in the phlox stems behind the leaf petioles, and the winter is passed in the egg stage. Near Washington, D. C., overwintering eggs begin to hatch early in May, and the nymphs develop to adults in a few weeks. Two or more generations develop. By midsummer all stages of the insect are present.

Treatment: The standard treatment in the past was to dust the plants with sulfur alone or mixed with pyrethrum every 10 days. Dusting or spraying with DDT is much more effective. In the fall the old stems, which contain the overwintering eggs, should be cut off and burned to prevent reinfestation the next spring.

Scale insects are of two general groups, the soft scales and hard scales. The soft scales are usually half-round and rubbery. The hard scales vary in shape and have a shieldlike covering. Scale insects usually are less than one-fourth inch long and of different colors. They may be found on any part of the plant. The young are referred to as crawlers and are active for only a short time after birth, when they infest the new growth and settle down for the rest of their lives. As a result of their feeding, copious amounts of honeydew are excreted by the soft scales. On this sticky exudation a sooty mold develops, giving the foliage, grass, and the other materials it covers a blackened appearance. The honeydew attracts ants, wasps, flies, and other insects. Many species of scales attack plants grown under glass and out of doors.

Among the soft scales of economic importance, especially in greenhouses, are the soft scale, hemispherical scale, and tessellated scale. Some of the important hard scales attacking outdoor plants are the San Jose, oystershell, euonymus, and rose scales.

Treatment: Apply miscible oil or oil-

emulsion sprays in the early spring to outdoor plants while they are dormant. Two applications of a summer oil, one just at the time the young are hatching and another 10 days later, are effective. DDT and parathion also can be used. In greenhouses, spray with a light oil emulsion, DDT, or parathion, when the crawlers are active. Fumigation with calcium cyanide or application of DDT, TEPP, and parathion aerosols are also widely practiced.

Spider mites, not really insects but relatives of the true spiders, feed by sucking juices from the leaves and other tender parts. The result is a stippled appearance of the foliage, which later turns pale and brown. Some species spin a fine web. Under a lens they seem to be minute, reddish, greenish, or yellowish spiderlike animals. Sometimes only the shed skins or the globular eggs or eggshells are present.

Some species winter in protected places, as among the buds or crowns of perennials and weeds, and attack the new growth as soon as it starts in the spring. Others hibernate in the egg stage on the bark and under the bud scales of trees and shrubs. In greenhouses the mites may develop rapidly.

The two-spotted spider mite is the species most frequently encountered on plants under glass and in the open. The cyclamen mite, broad mite, bulb scale mite, bulb mite, and spruce spider mite also are serious pests.

Treatment: For light infestations, frequent washing of the plants with a forceful stream of water has value but does not give complete control. Spraying with white-oil emulsions, alone or combined with rotenone or thiocyanate, is effective on outdoor and greenhouse-grown plants. Only one application every week or 10 days is usually needed. Spraying with tetracythyl pyrophosphate gives good results. Dusting with sulfur is effective in summer but in extremely hot weather it may burn the leaves of tender plants. Several commercial preparations that also are effective are mentioned in the chapter on spider mites, page 652. Aerosols con-

taining tetraethyl pyrophosphate, tetraethyl dithiopyrophosphate, or parathion are practical and effective against red spiders in greenhouses.

LEAF-MINING INSECTS feed on the plant tissue between the upper and lower leaf surfaces and cause the formation of blotchlike or irregular serpentine mines. Typical of the insects that produce the blotchlike mines are the boxwood, burdock, and arborvitae leaf miners. The columbine and holly leaf miners make serpentine mines.

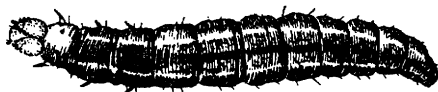
Some forms, like the azalea and lilac leaf miners, after mining the inner tissue of the leaves for a short period, abandon the mine, roll or tie the leaves together, and feed on, or mine, the opposing leaf surfaces. Others, like the greenhouse leaf tier (also called the celery leaf tier), have the latter habit, but do not mine the interior of the leaves.

The boxwood leaf miner is a very small fly whose larvae, or maggots, feed inside the leaves. Their mines appear as blotches or blisters on the lower leaf surface. When they are numerous enough, they kill the leaves and thus disfigure the plant. The tiny yellowish-orange maggots require a year for development, from the time of hatching in late spring until the following spring, when they transform to pupae within the mines. The orange-colored, gnatlike flies emerge from the leaves over a period of about 2 weeks, usually starting during the first or second week in May around Washington, D. C., and deposit their eggs in the under side of the new leaf tissue. Emergence starts earlier farther south and later in States to the north.

Treatment: Just before the adults appear in spring, spray the under side of the leaves with parathion wettable powder or with DDT or chlordane in the form of an emulsion or a wettable powder. It is advisable to add a spreader-sticker to the DDT or chlordane spray to cover the shiny or waxy surface. One thorough treatment should suffice for the season.

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The greenhouse leaf tier typifies the caterpillars that roll, fold, and tie together the leaves and terminal growths. It feeds on the inner surface of the folded leaves. Sometimes it eats into the bud and flowers. It is chiefly a greenhouse pest. It also attacks many



Greenhouse leaf tier.

flower-garden plants. The full-grown caterpillars are yellowish-green and about three-fourths inch long. The adult is a small, tan-colored moth.

Treatment: Dust heavy infestations with pyrethrum, making two applications at 30-minute intervals. Spraying with lead arsenate, pyrethrum, or DDT is also effective.

GALL-FORMING INSECTS sting the plant cells. Thereby they stimulate growth and cause the formation of gall-like structures of various sizes and shapes near the point of attack. Among them are the spruce gall aphids, the chrysanthemum gall midge, the beaked willow gall midge, and the dogwood club-gall midge.

The eastern spruce gall aphid occurs mostly in the eastern half of the United States. It causes small, conelike swellings or galls, which may develop on the base of the new shoots of Norway, white, black, and red spruce trees. The galls are usually about three-fourths inch long and resemble miniature pineapples. Many of the infested twigs die. The tree may be deformed and weakened by heavy or repeated infestations.

The tiny, bluish-gray, young aphids, or nymphs, spend the winter on the twigs, principally at the base of the buds. In the spring they develop into wingless adults, which are covered with a white cottony secretion and lay groups of eggs. The young begin feed-

ing at the bases of the new needles, causing the development of galls, which enclose the insects. In August the galls turn brownish and open, permitting the emergence of the maturing aphids. These develop wings and lay groups of eggs on the needles, which soon hatch. The young aphids overwinter near the buds.

The Cooley spruce gall aphid causes galls on blue, Engelmann, and Sitka spruces in the West and East. The habits of the aphid resemble those of the eastern form except that the winged adults, upon emerging from the galls in July, migrate to Douglas-fir, where they lay groups of eggs on the needles and where the young pass the winter. In the spring they mature and produce a summer generation, at which time many of the winged adults return to the spruce trees.

Treatment: If only a few galls occur on small trees, the infestation can usually be controlled by cutting off and destroying the fresh galls before the insects emerge. In larger plantings, spray the terminals of the Norway, white, black, and red spruces and the Douglas-fir early in the spring before the buds begin to swell. Take care to wet the buds and twigs. A spray of 2 percent white-oil emulsion, nicotine sulfate, soap, and water is recommended.

The chrysanthemum gall midge, a fragile, orange-colored, two-winged fly, is common and persistent in greenhouses. Larvae or maggots, hatching from orange-colored eggs deposited on the surface of tender tips and new growth, bore into the plant tissue. Cone-shaped galls are formed by the plant as a result of the irritation. The fully developed galls are about one-twelfth inch long and occur on the leaf, stem, or flower head of the plant, projecting obliquely from the surface. Both larvae and pupae complete their development within the gall. Development from egg to adult takes about a month. There may be six generations in a year.

Heavily infested plants fail to bloom

because of the dwarfed and gnarled condition of the growth. If the plants are attacked when the crown buds are forming, the flowers are not borne upright as normal flowers should be.

Treatment: Frequent fumigation at night with hydrocyanic acid gas or nicotine, supplemented by spraying with nicotine sulfate and soap solution, formerly was used to kill the adults. Spraying or dusting with DDT now is employed instead to kill the adults and immature stages within the galls. DDT aerosols also are effective.

TIP- AND STEM-INFESTING INSECTS include the larvae of certain beetles, moths, and flies. Their activity is more or less concealed and often not detected until considerable damage has been done. It consists mostly of hollowing out or tunneling the terminal buds, shoots, or main stems of flowers and shrubs. Examples are the pine tip and shoot moths, stalk borer, iris borer, lilac borer, dogwood twig borer, rose stem borers, rhododendron borer, and the flatheaded apple tree borer.

Pine tip moths, as small larvae or caterpillars, may hollow out and kill the tips of the new shoots, including the buds, of pine. The presence of short, dead needles near the apex of the new shoots, with partially developed or hollowed-out buds, is typical of this type of injury. Young pines, up to 12 feet tall, are most seriously affected and may become stunted and bushy from continued heavy infestation.

Several species of tip moths occur in different areas. The Nantucket pine moth is the common species through the East and South, east of the Mississippi. The larvae are yellowish and about one-half inch long when full-grown. There is one generation each season in the North, two in the Central States, and at least four in the South. The insects winter as pupae in the injured tips. In the northern Great Plains a variety of this moth winters in cocoons in litter or soil. Other species in the Southwest and West usually have one generation late in the spring

and pass the remainder of the year in the ground.

Treatment: On a few trees, the Nantucket pine moth is controlled by cutting off infested tips and destroying the overwintering pupae before growth starts in the spring. In the northern Great Plains and the West, that should be done as soon as the dying needles become evident and before the larvae have left them, because the larvae pupate in the ground.

Considerable protection may be had by spraying the terminal branches with a DDT emulsion about the time the adult moths begin to emerge. Once the eggs hatch and larvae have penetrated the stem, the chemicals have little effect on them.

The European pine shoot moth is another species that causes serious injury to the terminal buds and stems of red, Mugho, and Scotch pines. It is controlled in much the same manner as the tip moths. In New England the best way is to make two applications—one about the last week in June and one the first or second week in July.

The stalk borer is the chief offender of the several species of caterpillars that bore and tunnel through the stalks of fleshy and thick-stemmed plants. Aster, cosmos, dahlia, delphinium, goldenglow, hollyhock, lily, peony, phlox, and zinnia are often attacked. Before the insect is discovered its attack usually has progressed to the point where wilting and breaking over the plants occur. An examination of affected plants will disclose a small, round hole in the stem. It is the entrance to the stalk borer's burrow and the opening from which the castings are expelled. By splitting the stalk lengthwise one may find the culprit, a slender caterpillar that is a little over an inch long when full-grown. It frequently moves from the stem of one plant to that of another and may cause considerable damage. The young caterpillar is brownish and bears a dark-brown or purple band around the middle of the body, with several conspicuous, lengthwise brown or purple

stripes. The grayish-brown moths appear late in summer and deposit their eggs for the next season's brood on burdock, ragweed, and other plants.

Treatment: The best remedy is clean cultivation and the burning of all stems and all plant remains in and about the garden that may be likely to harbor the overwintering eggs. The growth of large weeds, especially the giant ragweed, should be prevented, or the weeds should be cut, raked together, and burned before the caterpillars in them can escape and migrate to garden plants. Individual plants in home gardens may be saved by splitting the infested stems lengthwise, removing the borers, and then binding the stem together again. Injecting pyrethrum, DDT, or chlordane into the burrows will kill the borers that can be reached by the insecticide. Application of DDT and chlordane sprays to the stems will help prevent the borers from entering them.

The iris borer injures the roots and crowns of iris, including the Japanese and the Siberian types. Decay and blackening, giving a tear-stain effect to the leaves of infested plants, usually indicate its presence. The injury becomes more evident during July and August. In heavy infestations entire plants are killed. The full-grown worm is usually pinkish, with a brown head, and about 2 inches long. Pupation takes place in the soil near the base of the plant. The adults, brownish moths that appear in the fall, lay overwintering eggs, preferably on dead or dry leaves. The young caterpillars, on hatching in the spring, gnaw their way into the leaves and then work down to the roots, which they hollow out completely.

Treatment: If only a few plants are concerned, watch for the tear-stained mines of the young larvae in the leaves and kill them by squeezing the infested portion between the thumb and forefinger, commencing at the ground and pulling upward. In the late fall or early spring cut off and destroy the old dried leaves so as to eliminate many of the

overwintering eggs. Protect the new growth as it develops in the spring by spraying or dusting at weekly intervals with DDT. Older plants should be lifted in July and August and all unsound portions together with any larvae contained therein should be cut out and destroyed by burning.

The lilac borer often attacks lilacs, privet, and other ornamental shrubs. It tunnels under the bark and into the wood, weakening the stems or girdling them and causing the foliage to wilt. Roughened scars showing the old borer holes may occur on the larger stems at places where the borers have worked for several seasons. The caterpillar is creamy white and about three-fourths inch long when full-grown. It passes the winter in the tunnels in the stems. The adult, a clear-winged moth, emerges in the spring and early summer and usually lays its eggs on roughened or wounded places on the bark.

Treatment: Before spring, cut and burn any dying and unthrifty stems containing the borers. In summer, watch for evidence of fine boring dust being pushed from small holes in the bark by the young borers and cut these out with a sharp knife. Borers that have entered the wood can be killed by injecting a few drops of carbon disulfide into the tunnels. The openings should be closed immediately with some gasproof material, such as grafting wax, putty, or wet clay, and kept closed for a day or two to retain the fumes. The fumes are poisonous and inflammable, and care should be taken when handling the chemical to avoid inhaling it or bringing it close to an open flame. Further protection may be had by spraying the trunk of the tree with a 1 percent DDT or BHC emulsion just before emergence of the moths.

SOIL- AND ROOT-INFESTING INSECTS crawl on the surface of the soil or work through it to reach the underground portions of the plants, such as the roots, bulbs, corms, and tubers. They feed on the exterior surface or

bore into and tunnel the parts they infest. Some of the insects begin their attack above ground, but the principal damage is caused below ground. Examples of the surface-infesting forms include ants, millipedes, slugs, and snails. The black vine weevil, strawberry root weevil, narcissus bulb fly, wireworms, and the white grubs are among the boring types.

Ants are annoying and occasionally injurious in flower gardens. Sometimes they damage plants by nesting among the roots and exposing them to drying. Some ants also may carry off newly planted seeds. Sometimes they are indirectly injurious through their habit of colonizing and protecting aphids, mealybugs, and certain scale insects. They are often merely annoying, being attracted to plants by the presence of aphids or other sucking insects which are excreting quantities of honeydew. Ants are also attracted by souring sap from tree and plant wounds and by sweet secretions of certain parts of the plants, such as the flower buds of peonies.

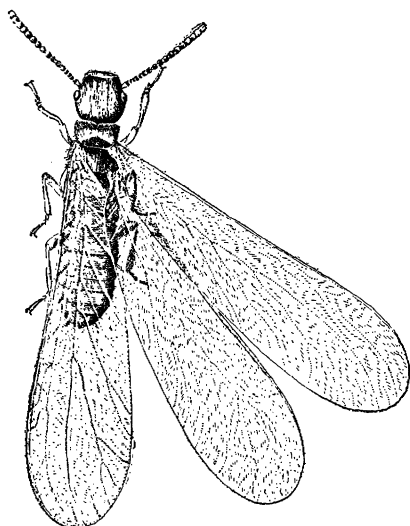
Treatment: Ants are difficult to control. No entirely satisfactory remedy is available that will serve under all conditions and for all species. Many species are controlled by chlordane, used as a wettable powder or emulsion spray or as a dust in the manner and dosage suggested by the manufacturer. Some species can be controlled with rotenone dust.

When honeydew attracts the ants, the insects producing the material should be gotten rid of.

Termites occasionally work in the roots of living plants, hollowing them out, extending their burrows up into the stems, and causing them to wither and die. Although the stems may be honeycombed, there is usually no external evidence of termites above ground because the outer surface of the stem is left intact. These termites are subterranean in habit and live in colonies in the soil. They normally feed on dead or decaying wood, form boards, stakes, or dead vegetable mat-

ter in contact with the ground. If the termites are numerous in the soil and this type of food becomes scarce, they are attracted to living roots of trees, shrubs, and flowering plants.

Treatment: Remove all infested



Reticulitermes flavipes, a termite.

wood and dying plants, and drench the soil with chlordane, using an emulsion or a wettable powder. The temporary substitution of commercial fertilizers for manure is often beneficial. Treatment of all plant stakes with suitable wood preservatives, as copper sulfate, zinc chloride, pentachlorophenol, and copper naphthenate will protect the wood from termite attack.

Millipedes, pillbugs, slugs, and snails are often troublesome to flowers and shrubs located in damp and shaded places where decaying vegetation is abundant. Millipedes often attack sprouting seeds or roots and bulbs. Pillbugs, sowbugs, feed on the tender roots and shoots. Slugs and snails feed on the leaves, stems, or roots of plants.

Treatment: Poisoned baits have been used extensively, but they are being replaced largely by the chlorinated compounds. For millipedes and pill-

bugs use DDT, toxaphene, or chlordane. For slugs and snails, baits containing calcium arsenate plus metaldehyde are most effective, especially with high temperature and low humidity. These recommendations apply outdoors and in greenhouses.

The black vine weevil is typical of snout beetles that attack stems and roots. The needles of yew, especially on the innermost branches, are bitten off at the tip along one side or eaten completely by the adults. They also feed on the bark of the stems and branches above ground. The young, white, grublike larvae feed on the rootlets, and later girdle or strip the bark from the larger roots. Arborvitae, astilbe, maiden-hair fern, gloxinia, hemlock, primrose, rhododendron, tuberous-rooted begonia, and wisteria are among the more than 75 greenhouse and outdoor plants this pest attacks. Outdoors, the insect usually breeds on strawberry, yew, rhododendron, or on such weeds as dandelion or broadleaf plantain. The adult is black with patches of yellowish hair scattered over its roughened body and is about two-fifths inch long. The winter is passed mostly as nearly full-grown larvae or as pupae. The wingless adult females emerge in June and July. There is one generation a year.

Treatment: Spray the above-ground parts of the plants with arsenate of lead, DDT, chlordane, or BHC in the form of emulsions or wettable powders late in June or early in July to kill the adults. This will prevent feeding on the bark and oviposition. Poison baits containing calcium arsenate, bran, and molasses are also useful. To control the ground-inhabiting grubs, the sprays or powders made of DDT or chlordane must be mixed with the soil.

Additional information on the biology and control of the insects mentioned in this article will be found in the publications cited, as well as in articles published on the subject by the various universities and agricultural experiment stations throughout the country.

THE INSECTS we have mentioned here are examples of a large number that infest flowers and shrubs. The measures we recommend against a specific insect often are effective against others of the same group. That they be controlled is of growing importance, just as the plants they infest are of increasing importance to home owners, gardeners, commercial florists, and nurserymen throughout the United States.

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For further reading on pests of ornamentals, the authors suggest:

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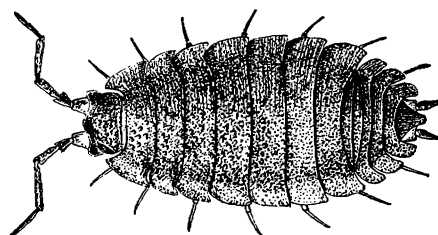
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Slug.



Millipede.



Sowbug, or pillbug.